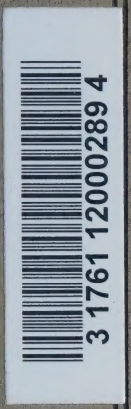
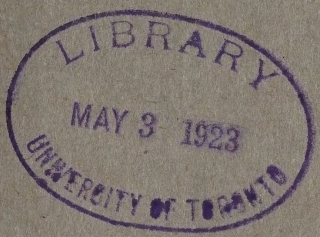


MODERN ORCHARD PRACTICES

By M. B. DAVIS, B.S.A.,
Chief Assistant to the Dominion Horticulturist



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DIVISION OF HORTICULTURE
DOMINION EXPERIMENTAL FARMS

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PUBLICATIONS ON APPLE CULTURE

The following publications of the Department of Agriculture relating to Apple Culture are available on application to the Publications Branch, Department of Agriculture, Ottawa:—

Bulletin 68.....Hardy Apples
Bulletin 79.....Renovation of the Neglected Orchard
Bulletin 86.....The Apple in Canada

A Nova Scotia apple tree, 150 years old and "still going strong."

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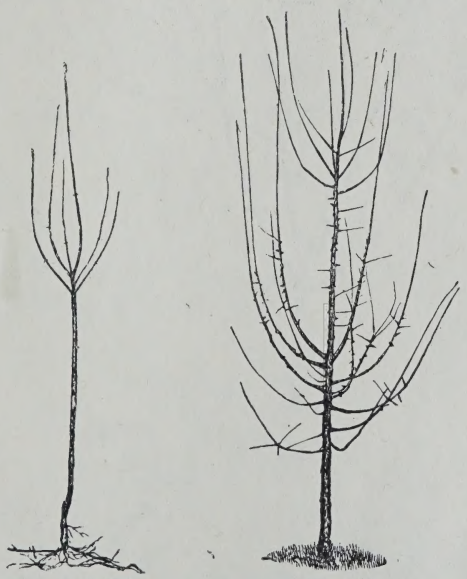
MODERN ORCHARD PRACTICES

Horticultural science is to-day making rapid strides in the solution of problems upon which light has long been wanting. Scientific research is unearthing a wealth of material, much of which offers practical solutions or, at least, suggestions for some of the difficulties in profitable orchard management. Pruning recommendations to-day are radically different from those of a few years ago, and the new recommendations are based on experimental results. The much discussed fertilizer problem is now being studied from a plant physiological and biochemical standpoint, which, together with external observations, has enabled us to see this problem in an entirely new light, and although definite rules cannot, and perhaps never will, be made, on account of differences of location and types of soils, many helpful and suggestive recommendations have been the outcome.

Fruit bud formation is another phase of recent study and its close relation and interdependence upon fertilizer practice and pruning make it necessary to treat these three problems almost as one and he who would understand one must have a knowledge of the others. The day of definite instructions applicable to all districts and sets of orchard conditions has passed. The most one can hope to accomplish is to aid the orchardist to grasp the principles underlying successful orchard management and to indicate these principles by citing a few typical examples of entirely different conditions and leave to the grower himself the application of these principles to his own conditions.

TRAINING THE YOUNG TREE

One of the most important operations in the management of a young orchard for the first two or three years after planting is the proper training of the trees.



Two-Year Old Apple Tree Marked For Pruning.

Three-Year Old **Low-headed Apple Tree**

Fig. No. 1. Central Leader Type.

The word " training" here is used in distinction from the word "pruning," for the object of any pruning practice adopted for the first few years of the life of a

tree is primarily to obtain a tree of proper form and shape and is essentially a training process, whereas pruning proper is conducted primarily to maintain proper functioning of the tree as a fruit producing or commercial proposition.

There are, in general, three main types of tree which may be chosen as ideals. These are the central leader or pyramidal form, the open centre and the modified central leader.

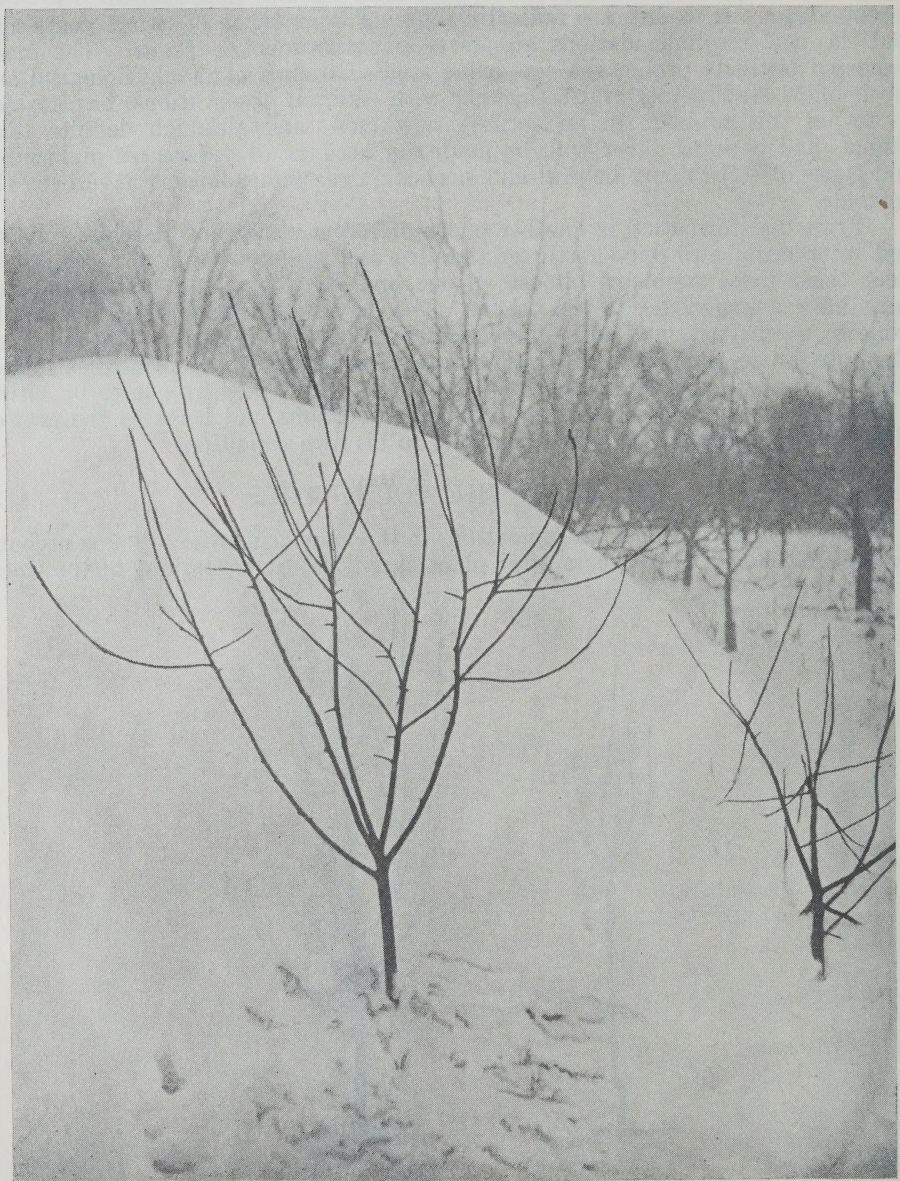


Fig. No. 2. Open centre type of tree.

Central Leader Type.—The first mentioned, namely the central leader type, is probably the strongest and consists of a central leader or main stem growing to the full height of the tree, from which lateral branches radiate. (See

fig. 1). Such a tree, although capable of withstanding much strain, has the disadvantage in later years of becoming too shaded in the lower portions, with resultant loss of many limbs due to lack of leaves and consequent food supply. It is, moreover, apt to become too tall in proportion to its spread, resulting in difficulty with regard to spraying, in addition to a comparative reduction in fruiting surface.

Fig. No. 3. Modified leader type of tree.

Open Centre Type.—The second type has the disadvantage of being a very weak tree, for in this type the main branches originate from almost the same locality on the main trunk and generally split apart, often with complete loss of

the tree. This style of tree, however, offers greater possibilities for the maintenance of a large fruiting surface than the former and, as the centre is comparatively open and the tree more spreading in habit, it is generally better for the production of high-coloured fruit than is the central leader type. (See fig. 2).

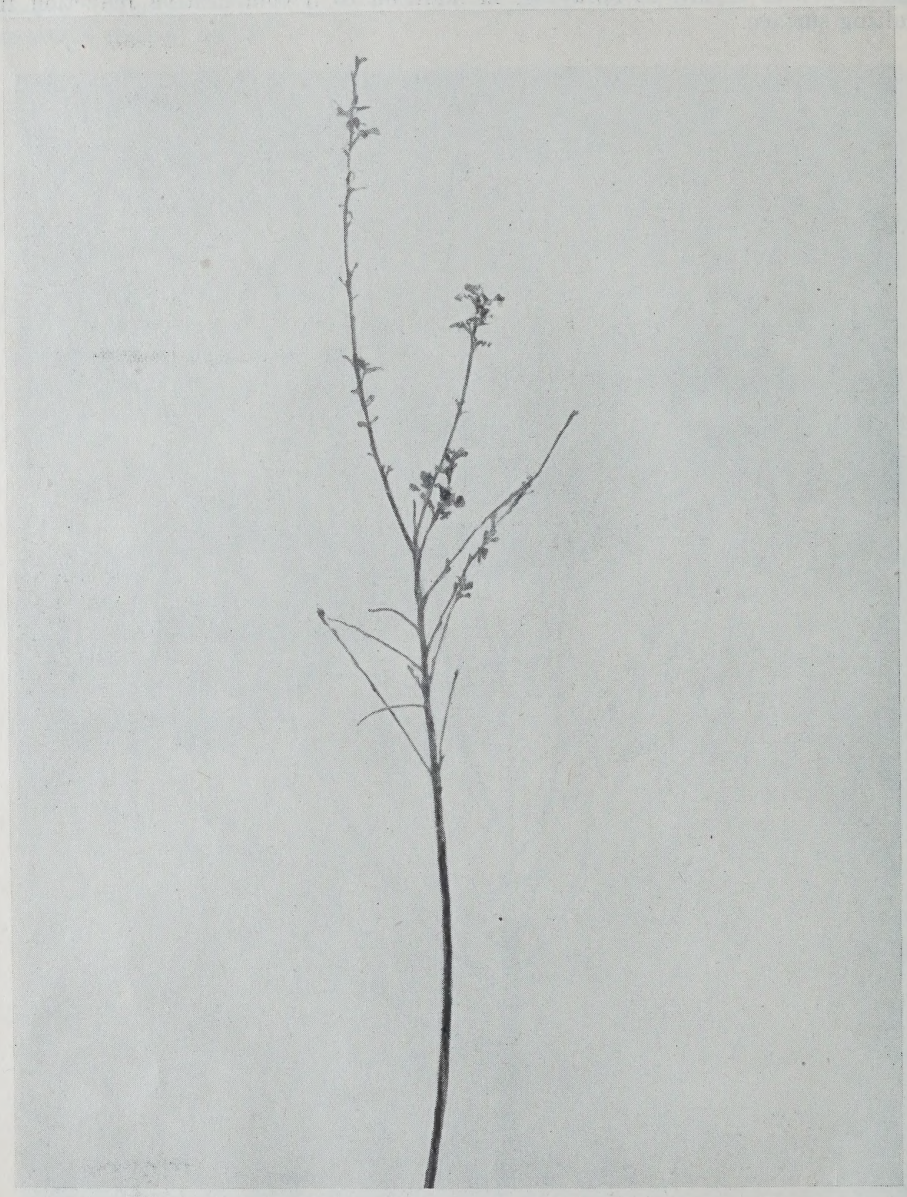


Fig. No. 4. All the branches in this tree are sharpangled.

Modified Central Leader.—The third type is a modification of the two previous ones and is recommended in preference to either. In this type the central leader is allowed to grow to a height of about three feet so that the main scaffold limbs of the tree can be properly spaced on it without originating from

the same locality. After the main limbs have been obtained, the central leader is cut out and the tree from that time takes on the form of an open-headed or open centre tree, giving the grower the combined advantages of the open centre and the central leader types.

Fig. No. 5. The same variety as in Fig. No. 4, but forming a better crotch angle.

SELECTION OF CROTCHES A VITAL FACTOR

Having decided upon the form or type of tree to be grown, attention must then be paid to the selection of the main or scaffold limbs, generally about five or six in number. In this connection, the angle at which the branch leaves the

main trunk is a determining factor. Branches which leave the main trunk at an acute angle form weak crotches and will easily split. These should be cut out and those branches which form almost a right angle with the main trunk selected to form the original framework or scaffold of the young tree. The avoidance of these sharp-angled or weak crotches is a vital factor in all pruning practice, as a little attention paid to this one point may in future years avoid the loss of a large number of trees, due to splitting.

HEADING BACK THE YOUNG TREE TO BE PRACTISED WITH CAUTION

During the first few years of a tree's life it is necessary to practice annually some heading back, but in many instances in the past this has been very largely overdone, with a resultant delay in fruiting and a general weakening of the tree. Although, when a tree is severely cut back, it may produce new shoots of greater length than if it had not been cut back, it is a mistake to assume that it is making a greater growth than unpruned trees. In recent experiments at the Central Farm and elsewhere, it has been found that trees cut back severely each year have not made as great a girth or as large a total growth as those not pruned at all. Severe heading back has a devitalizing effect and only delays the time when the tree will commence to bear. Some pruning and possibly heading back, however, is necessary, for to leave a tree unpruned for any length of time would result in too thick a top and probably such a poorly pruned tree that it would require too drastic treatment later in its life to rectify the earlier mistake of neglect of pruning. For the first two or three years the object of pruning is to train the tree and induce the growth of properly spaced lateral branches, which in future years will produce fruit bearing wood. This is accomplished by a combination of light heading back and cutting out, as will now be described.

THE FIRST YEAR AFTER PLANTING

Commencing with the second spring, or the first year after planting, the tree is pruned so that the central leader will maintain the lead, and from two to five other branches should be selected, as previously mentioned. All other branches are removed and the remaining selected ones are cut back a short distance, cutting the weaker ones the least. As these main branches will probably have some laterals on them it may be advisable to remove some of these at this time if they are not properly spaced. At this juncture it might be mentioned that the habit of the variety in question will often decide much of the treatment to be given. For instance, with some varieties which are prone to produce very long, rangy growths, with few laterals, more heading in and careful handling are required than with one which naturally produces many laterals, in which case the treatment becomes more of a system of thinning out. With those sorts producing the long, rangy growth, much can often be gained by a combined system of summer and spring pruning. Early in summer, say mid June, the branches cut back in the spring will have put forward considerable growth and as soon as this growth has reached a stage where laterals can be spaced on it, pinch back the terminal growth which will force out laterals close to the point of pinching and thus a season may sometimes be gained. But it must be borne in mind that this pinching should be done early and is only recommended for varieties or trees producing long growths with few lateral branches, thus necessitating rather severe heading in under ordinary procedure. It is the common practice to let these terminal growths grow until the following spring, or even for two years, when it is found necessary to remove a foot or more of new wood in an endeavour to force out lateral growths. This means a waste of energy, for one could have cut back to that same point in early summer without reducing the leaf surface of the tree to any extent. The idea is to economize in tree energy, as constant large reductions of leaf and wood area not only delay the age at which the tree will fruit, but reduce its ultimate size and vigour.

THE SECOND SPRING AFTER PLANTING

By the following spring, each of the branches pinched back in summer will probably have a number of laterals attached to them. All these laterals but one for each main branch are removed, thus leaving twice as many branches as there were the previous spring. Select, of course, the best spaced and strongest

Fig. No. 6. Showing a lateral branch leader of the same length, the lateral being cut to allow the leader to develop and thus avoid a weakened crotch.

branches in every case. In selecting these laterals make certain that the lateral is not cut the same length as the main branch, or the result will be weakened crotches. This is illustrated in Figure No. 6.

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THE THIRD SPRING AFTER PLANTING

The orchard has now arrived at the summer of the third year after planting and should be well established and in good condition. A considerable amount of new growth will have been put out and again it will be advisable to look to the establishment and placing of lateral branches. This should be accomplished with as little top removal as possible, so, if the tree shows a tendency towards rangy growths devoid of laterals, the practice of early summer pruning may again be adopted. During this third summer lateral branches formed the previous season should produce sub-laterals and thus be building up a large fruiting area for future performance.

COMMENCING WITH THE FOURTH YEAR

Commencing with the fourth spring it should only be necessary to clip back too long or rangy laterals and thin out the undesirables and cross branches. During the summer attention should be paid to too strong growing branches, suppressing the stronger to give the weaker an opportunity to develop. Heading in or top removal should be kept down to the utmost minimum from this time on, as the tree should now be approaching fruiting age.

COMPLETION OF THE TRAINING AGE

As the tree has by this time (the beginning of the fifth season) almost passed through its training period, pruning practices should be altered slightly to conform with the desired functions of the tree, namely vegetative extension and fruiting. Properly to understand the principles underlying any system of pruning designed to maintain the fruitfulness of a tree, some idea must be gained as to the relation which exists between a pruning practice and the nutrition of the tree. This involves a consideration of fertilizer practice. The reader's attention will therefore now be turned to a study of *the relationship which exists between fertilizer practice, pruning and profitable fruitfulness of the tree.*

In the preceding pages of this bulletin, it has been shown that to produce a tree of desired type and form, one should guard against swinging from severe pruning to absolutely no pruning for a considerable period, the sequel of which would ultimately be a rather too severe heading back and cutting out to correct past neglect, with a possible consequent upset in the balance between the supply of nitrogen and carbohydrates. In short, more or less severe heading back and thinning out during the first four years after planting may be necessary to mould the form of the tree and may be practised without economic loss of vigour. After that, however, severe annual pruning should be discontinued and trees that are bearing annually should receive light annual pruning, sufficient only to maintain symmetry, to prevent too long or rangy growth and to prevent the establishment of long limbs with growth only at the tips. The principles which lie behind these pruning recommendations will be discussed later in this bulletin. In the meantime let us consider the status of orchard fertilization.

Science has given us some general principles which should materially assist many in reducing their fertilizer bills. Kraus and Kraybill have shown (1) that there must be a correct balance among nitrogen, carbohydrates and moisture before we can get fertilization and vegetation combined; (2) that an abundance of moisture and nitrogen without an available supply of carbohydrates results in weak and unfruitful plants; (3) that an abundant supply of nitrogen and available carbohydrates gives increased vegetation and non-fruitfulness; and (4) that lack of nitrates with available carbohydrates is similar in results to an abundant nitrogen supply and a low amount of carbohydrates, that is, weakened and unfruitful plants result.

There must exist, therefore, an available supply of carbohydrates, available moisture and a sufficient, but not an over abundant, supply of nitrates, if fruitfulness and vigour are to be obtained. In short, it is not so much the absolute amount of each fertilizing element present that counts, as their proportion to one another. This is pointed out to show how easy it is to upset the proportion between nitrates and carbohydrates and thus throw trees out of bearing.

Nitrogen is taken up by the tree from the soil in the form of nitrates and, without an available supply of water, nitrates, even though abundant, cannot be utilized by the plant, as they enter the root in solution. It is easy to conceive, therefore, of a condition where moisture might be the limiting factor and not nitrogen or carbohydrates. Carbohydrates on the other hand, are complex substance, such as starches, sugars and natural gums, composed of carbon, hydrogen and oxygen in varying proportions, which are manufactured by the leaves of the plant from the constituents entering the roots in the form of solution and from the carbon dioxide taken in by the leaves from the air.

Unless artificially supplied to the soil, the plant is dependent for its nitrogen upon processes known as nitrification, wherein unavailable supplies of nitrogen are changed into nitrates and thus made available for plant consumption. Nitrification requires a comparatively warm and well aerated soil. As trees start into growth early in spring before the soil temperature is relatively high, it is conceivable that nitrification processes are at that time not very rapid and, except on soils rich in nitrogen, the actual supply available for the plants at that time of year is probably insufficient for the plant's needs.

Carbohydrates are manufactured by the leaves and it should be here added that any quantity of carbohydrates in excess of what is required for the immediate consumption of the tree is stored in the form of starches in that portion of the tree close to the leaves which manufactured it. This is the condition of healthy trees during the winter, namely stored reserve supply of carbohydrates within the plant tissues. Although there is some storage of nitrogen, practical experiments indicate that the tree in early spring calls upon the soil for a further supply of this element.

Soil nitrification being slow in the spring and slower still in a cold, wet spring, early applications of nitrate of soda often result in increased productiveness. Without available nitrogen at this time of year, the carbohydrates are in too large proportion to the nitrates with resulting suppression of both vegetation and fruitfulness. Not only is the actual ratio existing between the available nitrates and carbohydrates out of proportion, but the manufacture of carbohydrates in the immediate future might be in danger of being limited, due to lack of available nitrates. Carbohydrate manufacture is dependent, of course, upon the leaves, leaf expansion is largely influenced by nitrogen supply, and fruit bud formation is dependent upon an available supply of carbohydrates at the critical period, so here is another way in which a shortage of available nitrates at the critical period might prevent proper fruit bud formation. Although an early application of nitrogen will give desired results it is not to be presumed that applications made in mid-summer or late spring will do likewise. At these seasons soil nitrification is at its height and further applications of nitrates would probably result in increased vegetative growth of the tree, and if the supply of nitrates continued to be abundant or in excess as compared with the carbohydrate content of the tree, late vegetative growth with resultant winter injury may take place. It is not unusual to see trees injured by the application of nitrates, not that the nitrates have a toxic or deleterious effect upon the plant, but the presence of too much available nitrogen late in the season causes the tree to enter the winter with unripened wood, with subsequent winter injury showing up the following year.

Where nitrates have not been used and trees in spring present considerable yellow leaf and an unthrifty appearance, recovering later in the season, an application of five pounds of nitrate of soda per tree the first year is not out of place, but to continue this amount annually might result in over stimulation so that the grower must, by intimate study of his trees, decide upon the frequency and quantity of these applications. These early applications of nitrogen may materially assist in maintaining annual bearing by establishing a correct balance between carbohydrates and nitrogen supply. In orchards grown on sod, where little nitrogen has been supplied, an application of nitrates will work wonders in productiveness. In such instances the trees already have an abundant supply of reserve carbohydrates, but lacking nitrogen are unable fully to utilize these reserves for vegetative extension and fruitfulness.

(Courtesy of Agricultural Experimental Station, Storrs, Conn.)
A high headed tree badly in need of repair.

It might be well to point out here that this balance could, temporarily, at least, be obtained by severe pruning, for by such a practice the leaf area is reduced with a consequent reduction in available carbohydrates, thus relatively increasing the nitrogen carbohydrates ratio. Probably in the case of older trees which are barren, a moderate heading back under such circumstances, accompanied by a light application of nitrates would be a better means of establishing the proper balance. All this tends to illustrate that nitrogen is not only essential for vegetative extension, but for fruitfulness as well; that there is close relationship between vegetative extension and fruitfulness and that the two are not diametrically opposed as has too often been thought.

At this juncture, reference should again be made to the abandoned practice of yearly heading back. What is the explanation of the poor vigour and delayed fruitfulness of trees grown under this system? Simply that in removing such large quantities of wood a considerable amount of carbohydrates as well as the future means for its manufacture were removed and a condition of relatively low carbohydrate content and abundant nitrogen supply resulted, with necessarily reduced vegetative vigour and delayed fruitfulness.

(Courtesy of Agricultural Experimental Station, Storrs, Conn.)

The same tree as shown on page 14, after pruning. This tree should have the top removed as shown by the white line.

We have seen then that there must exist a correct balance between the nitrates and carbohydrates; that this may be re-established by the addition of nitrate to the soil in early spring, and by early cultivation; or that by reducing the top of the tree, thus lowering relatively the carbohydrate nitrogen ratio, we can arrive at the same end, at least temporarily. Thus is established the close relationship between fertilizer practice and pruning.

MAINTENANCE OF FERTILITY.

In the few preceding paragraphs, the relation between nutrition and pruning has been pointed out. This involved a discussion as to the rôle of nitrate of soda, so that it will not be necessary again to repeat what has already been said in that connection. Attention will now be confined to the use of fertilizers other than nitrates and to the use of cover crops, which have an important bearing on the maintenance of fertility in the majority of orchards.

Although nitrate of soda appears to have given fairly good universal results, the use of the two other commonly recommended classes of fertilizer, namely phosphates and potash salts, has not met with such widespread success. The results from many orchard experiments are somewhat conflicting, so that it is practically impossible to make any very specific recommendations which will apply to general conditions. The results obtained seem to indicate that phosphate is more often lacking in orchard soils than is potash, and that the grower is warranted in considering its use.

Potassium, however, is also an essential element in fruit production, as it has been shown that bearing or fruiting apple spurs contain a considerable amount of potassium, whereas barren or non-fruiting spurs do not contain potassium to any appreciable amount. This indicates that potassium is one of the essential elements in plant nutrition and if not present in the soil in sufficient quantities should be applied artificially. As to the quantities of phosphate and potash to be applied per acre, there is little definite information that it is possible to give. Soils vary so much in their make-up and have been treated so differently that it practically becomes a problem for each grower to solve for himself, and on another page will be found suggestions for the establishment of a fertilizer test plot. That a regular system of orchard fertilization should be adopted with fruiting orchards is unquestioned. Small annual applications of commercial fertilizers should be made, otherwise the time will come when, owing to lack of fertility, the trees will present an unthrifty condition and hence become unprofitable investments.

MANURE VS. COMMERCIAL FERTILIZERS

If there is one part of the farm where commercial fertilizers can be used to advantage it is in the orchard. Here it is possible to make up for the lack of humus of the fertilizer by the use of cover crops, which may be turned under annually. Results from past work have clearly demonstrated the fact that commercial fertilizers, when properly used in conjunction with cover crops, will give as good results as the same amount of plant food supplied in the form of manure. In fact, if manure alone is used, the question of a sufficient supply of nitrates at the critical period in spring is not likely to be solved, for the nitrogen in the manure is not in as readily available a form as it is in nitrates. When manure is used the time of high nitrate liberation is generally somewhat after the period when it is most required, so that, briefly, it is recommended in orchard practice to depend upon the different forms of nitrogen, potash and phosphate as found in commercial fertilizers to supply the mineral elements of plant food.

THE QUESTION OF THE FORM IN WHICH TO PURCHASE FERTILIZERS

There are different forms of commercial fertilizers containing the three elements of plant food here discussed and, as there is considerable difference in their value, some attention should be paid that question.

Generally speaking, orchardists should avoid the ready-mixed or complete fertilizers for orchard use, no matter how valuable they may have found them for other farm crops. The reason for this, aside from that of economy, is the question of availability and proper proportions. Nitrogen contained in the average complete fertilizer is not in a very quickly available form and, as it has been shown that nitrogen should be applied in a quickly available form early in spring, it will be readily seen that the complete fertilizer will not fill the bill. This one fact alone is sufficient to condemn the general use of complete fertilizers as purchased in the trade. Nitrate of soda is probably the best form in which to apply nitrate, being quickly available and generally easy to obtain. Slowly available forms are to be generally avoided, except on excessively poor soils

where the nitrogen problem is always a vital one, even during late spring and early summer, in which case the nitrate might be supplemented by applications of tankage or blood meal.

The three most common forms of phosphate are acid phosphate, basic slag and bone meal. For sod orchards, acid phosphate, the most readily available form, should be used, but for orchards in cultivation probably basic slag meets the requirements as well as any form and possesses the added advantage of containing some lime, which will help to maintain proper conditions in the soil with regard to acidity.

Of the forms of potash, probably the muriate is the one to be most recommended for orchard use.

AMOUNTS TO APPLY

As previously stated, it is impossible and would be misleading, to recommend specific amounts for all conditions. Until such time, however, as the orchardist has determined his own needs in this respect, approximately the following amounts should be applied annually to a bearing orchard:—

Nitrate of Soda.—100 to 150 pounds per acre, applied very early.

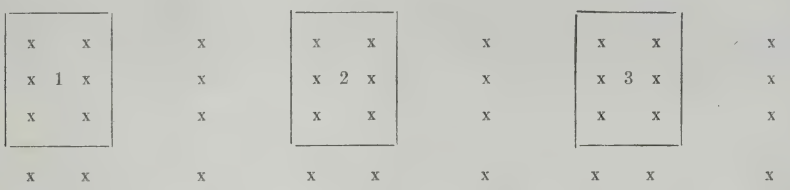
Acid phosphate for sod orchards.—150 to 250 pounds per acre, applied in spring.

Basic slag may be used instead of the above on cultivated orchards, using it at the rate of 250 to 300 pounds, applied either in fall or spring.

Muriate of Potash.—at the rate of 50 pounds per acre applied in the spring.

A Simple Fertilizer Experiment

Until such time as there is much more information available concerning the value of different fertilizers on different types of soils and under different conditions, commercial orchardists should attempt a simple set of fertilizer experiments under their own conditions. A plan of such a scheme is offered here for suggestion:—



In the above scheme six trees are included in each plot and there is a row of trees between each plot from which no record would be taken; they act as buffer rows. Three plots are considered in all and could be treated as follows:

No. 1, nitrogen only, applied in form of nitrate of soda early in spring.

No. 2, nitrate of soda applied early in spring, plus acid phosphate or basic slag.

No. 3, nitrate of soda applied early in spring, plus acid phosphate or basic slag and muriate of potash.

INTERPRETATION OF RESULTS

These applications should be continued over a three-year period and results not expected until the year following the first application. If none of the plots shows an increase in yield or results over the balance of the orchard, the use of fertilizers for the time being is not a vital factor in that particular orchard.

If plot No. 1 showed an increase it would be reasonable to assume that nitrates were of value. If plot No. 2 showed an increase over No. 1 it would indicate that under those conditions phosphates were required, and so on.

The cost of such a test would be negligible and the labour involved would be very slight, while the ultimate value in the economic application of fertilizers might mean many dollars in the grower's pocket.

SYSTEMS OF CULTIVATION

Different systems of cultivation are frequently practised and each may have its application to certain conditions. The more common of these are described below:

Clean cultivation with cover crop.—This is the most generally advocated of all systems and is considered the wisest and most economic of all from the standpoint of maintenance of moisture and fertility. It consists of maintaining a dust mulch in the orchard from early spring until some time early in July.

"Dehorned" Northern Spy in orchard of Jos. Tweddle. Ten to twelve feet was removed from the top.

By commencing operations as early as possible in spring, soil activity at the critical period is augmented and by the maintenance of the dust mulch throughout the major part of the growing season, soil moisture is conserved to the best advantage. The use of a cover crop in conjunction makes possible the maintenance of the humus content of the soil and on very poor soils where it is necessary to supply large quantities of nitrates the use of leguminous cover crops presents a moderately cheap means of supplying a large portion of the required nitrogen. By seeding down the orchard in early July, there will not be competition between tree and cover crop for moisture until late summer, at which period the tree ordinarily has more than a sufficient supply. This system, or a modification of it, is the one recommended for wide-awake orchardists wherever it is possible to practise it.

Clean cultivation.—This resembles the first mentioned system, but differs in the respect that no cover crop is sown and that generally the dust mulch is maintained throughout the entire summer. Such a system does not permit of the utilization of green manures to maintain humus content and is thus very wasteful of soil fertility, generally necessitating the use of fairly large amounts of barnyard manure for that purpose. It is not to be recommended for general adoption.

The rotation of cultivation system.—This has given excellent results in some localities and, where it is possible to practice it is probably as desirable as clean cultivation and cover crops. In orchards where the green apple bug or similar insects are prevalent, it may not be possible to adopt such a method, but where this pest has been kept under control by spraying it is well worth a trial. The system is to sow every other ridge to some good cover crop in the spring, and allow this crop to occupy the land for one full year. This leaves every other ridge to be kept cultivated until July 1, when it is sown to cover crop. The following fall or next spring the ridge which had been in cover crop all summer is ploughed and kept cultivated until July, while the other ridge is allowed to grow a cover crop for the whole season. This keeps on alternating year by year. There are two great advantages in this system: (1) lessened cost of labour, and (2) the increased supply of humus obtained by allowing the cover crop to hold the land for a whole year. Up to July first the ridge which is growing crop is cut every few weeks and the crop allowed to remain on the ground as a mulch.

The sod mulch system.—Much has been written in regard to the pros and cons of this and the cover crop method of orchard management. A large part of the misunderstandings has been due to a confusion of the sod system and the sod mulch. In the former the orchard is sown to grass and cropped each year. In the latter the orchard is sown to grass and the grass cut and allowed to remain as a mulch. In addition, during the first few years, until the cut grass has accumulated sufficiently to maintain a respectable mulch, old hay or other material is placed around the trees. On certain sites, such as hill sides, this method is preferable to any other, if proper fertilizer practice is adopted. Under such a system moderately large amounts of quickly available nitrates will be required as well as readily available phosphates and potash salts, as discussed under fertilizer practice. On heavy clay soils it is doubtful if this system would be ecomomical, but its possibilities on light soils may be appreciated by an examination of the following results from a small close-planted block of Wealthy apple trees growing at the Central Experimental Farm:

This orchard has shown every year a good net profit per acre, and is a striking example of the profits to be derived from an orchard in this district.

One feature in the management of this orchard should be especially noted; this is the fact that it is grown under the sod mulch system. This is possible largely because the trees are so close (10 feet by 10 feet) that excessive evaporation is impossible owing to the shade cast by the trees themselves. Although the trees were planted 10 feet by 10 feet, the entire block consisting originally of 144 trees, there are now only 73 trees left, the remainder either having died from winter injury or having been removed to make room for the other trees.

Special attention is here called to this system for the severe districts, where early-bearing varieties are being used. It is generally conceded that, after twenty or twenty-five years, in eastern Ontario and Quebec orchards are on the decline, so that when early-bearing sorts are planted the standard distance apart they practically never reach an age where all the land is fully occupied, being lost in later years by the ravages of severe winters. By this close-planting, sod mulch system, accompanied by removal of trees when necessary, there is no reason why returns fully as profitable as those here recorded should not be obtained.

A word regarding the use of the sod mulch would not be amiss. On light land, fairly well supplied with moisture, this system may be practised if properly handled. For the first year after planting, cultivation and probably intercropping should be practised. Commencing the second season, the whole may be seeded down or the intercropping continued for a year or so longer. If seeded down, the seeding should be done about the latter part of June, and a regular mixture of clover and timothy used. Up to the date of seeding, frequent cultivations, as in ordinary orchard practice, should be given to conserve the spring supply of moisture. During the first two years after seeding it will probably be necessary to supply some additional mulch until the cuttings from the sod supply a liberal mulch of their own. Frequent light applications of nitrate of soda in early spring are advisable, and a good manuring once in three years should be given if at all possible.

In orchard of Mr. Jos. Tweddle, Stoney Creek, Ont., showing "dehorned" R. I. Greening trees just after dehorning.

Detailed Returns from Closely Planted Wealthy Orchard for 1920

1,041 gallons of fruit picked

		Estimates per Acre
Sales of fruit—		
288 baskets at 75c..	$216 00	
69 baskets at 25c..	17 25	
Total..	233 25	
		$746 86
EXPENSES, 1920		
Mowing, one man, 5 hours at 40c..	$ 2 00	
Material for spraying..	12 20	
Spraying four times at $1.20..	4 80	
Rent of land at $12 per acre..	3 96	
357 baskets at 9c..	32 13	
Picking fruit, 56 hours at 40c..	22 40	
Packing fruit, 45½ hours at 40c..	18 20	
Total expenses..	$ 95 69	306 39
Net profit for the year..	137 56	440 47
	$233 25	$746 86

Returns from Closely Planted Wealthy Orchard Since Date of Planting

Net profits per acre, 1896-1914 (18 years)	$1,719 28
" " 1915	64 23
" " 1916	237 20
" " 1917	97 24
" " 1918	509 95
" " 1919	453 69
" " 1920	440 47
Total net profits per acre, 1896-1920 (including initial cost of trees and planting)	$3,522 06
Average yearly net profit per acre	140 88

The Sod Strip Method.—Another method is to cultivate strips between the rows, leaving a narrow strip of sod next to the trees. This works well if the sod next the trees is not cropped. If it is kept cut and the cuttings allowed to remain as a mulch this system is commendable and is especially suited to orchards where it is difficult to get very close to the trees.

A modification of the above is to cultivate next the trees, leaving the sod in the centre. In young orchards this is probably a good practice as the roots will not have spread to the centres of the rows, but in the old orchard it is not to be recommended.

Intercropping the Orchard.—The question often arises as to the practicability of utilizing the vacant land between the rows of trees. In young orchards, not too closely planted, where the trees are not utilizing all the available space, such practice may be adopted successfully. A strip of land as wide as the spread of the branches should be left close to the trees, and it is advisable that this be treated under the cover crop system. Hoed crops, such as potatoes, strawberries, etc., are to be preferred to crops of grain or grass as occupants of the land between the rows. Mistakes are often made when intercropping by attempting to utilize the land too close up to the trees. This is especially undesirable when an intercrop which requires a large amount of manure or nitrogenous fertilizer is being used, for in such instances the supply of nitrogen to the trees is greatly increased and late growth may be stimulated, with the result that injury due to winter killing is very liable to occur. Provided, however, that a reasonably wide strip is left on both sides of the trees, danger from this source is not very great. Instances have been recorded where tall growing intercrops, such as corn, when planted too close to the trees, have prevented the bark from properly ripening or hardening, with the result that a large number of trees were killed by sun-scald the following winter. Such tall intercrops, which shade the trunks too much in autumn, should not be grown very close to the trees.

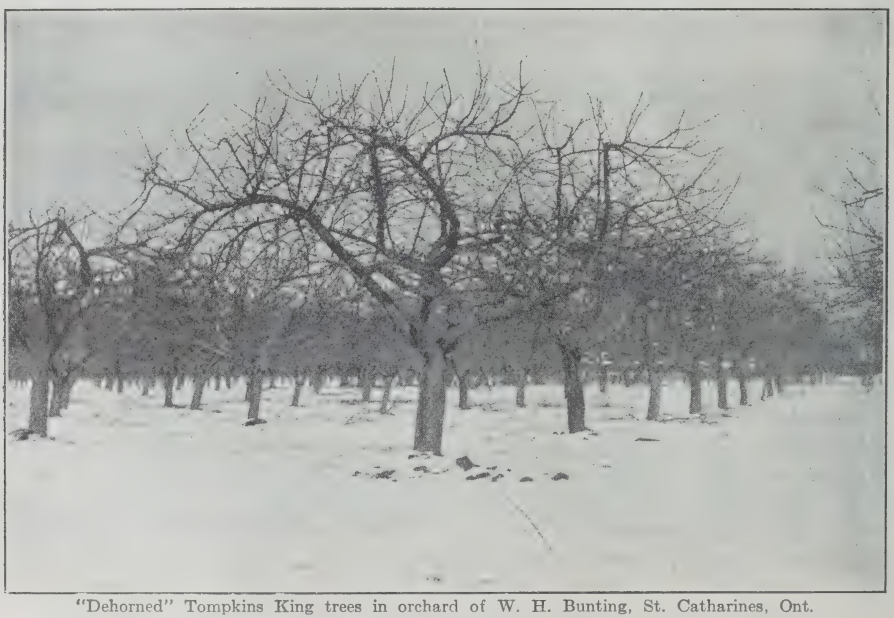
COVER CROPS

The following treatise on this subject is taken from Experimental Farms Bulletin No. 86, "The Apple in Canada," by W. T. Macoun, Dominion Horticulturist:—

"The importance of cover crops as a factor in the successful culture of large fruits is now well recognized, although it is only during recent years that much attention has been given to the subject. The main uses of the cover crop in the orchard are: to hold the snow in winter, and thus afford greater protection to the roots of the trees; to prevent the thawing and freezing of the ground; to lessen the depth to which the frost will go in the soil; to furnish vegetable matter in the spring for the purpose of obtaining humus and nitrogen; and to act as a catch-crop in autumn to prevent the leaching of plant food made available during the summer. The cover crop is also a means of reducing the moisture in the soil by transpiration, and thus aids in ripening the wood of fruit

trees liable to be injured. In certain parts of Canada, some of the uses of the cover crop are more important than in others and some plants are better adapted for special purposes, hence the plant which makes the best cover crop in one district may not do so in another. Where the soil has been long cultivated, as in the older settled parts of Ontario, and needs additional plant food, especially nitrogen, a leguminous plant, or one which will take free nitrogen from the air and thus add a large quantity of this useful and expensive fertilizer to the soil at slight expense, is usually best; while where the soil has not been long under cultivation and is well supplied with humus and nitrogen, a non-leguminous plant may be better, as the holding of snow and the protection of the roots of the trees is more important than adding fertility to the soil, especially where the snowfall is light.

"In the colder parts of Canada, where there is usually plenty of moisture in summer, it is better to sow seed for the cover crop in the first half of July, rather than in the second half, as it is important to have the wood of trees thoroughly ripened before winter sets in, and by sowing the seed early the



"Dehorned" Tompkins King trees in orchard of W. H. Bunting, St. Catharines, Ont.

growth of the tree should be aided in ripening by the drying of the soil caused by the transpiration of moisture from the growing cover crop. In the dryer and milder parts of Canada it is not necessary to sow seed for the cover crop until about the middle of July, as the early ripening of the wood is not so important as the conserving of moisture in the soil by cultivation through the early part of the summer. After the seed is sown the soil should be rolled with a heavy land roller, which will cause the moisture to rise to the surface of the soil and assist the germination of the seed. This rolling is very important, as should the seed lie in the ground for any length of time without germinating there will not be time for a good cover crop to be formed before winter. No nurse crop is, as a rule, necessary. Some of the desirable characteristics of a good plant for cover crops are, first that it will germinate quickly and grow rapidly, so that weeds will be checked. It should be a strong grower, as there should be a dense cover to prevent the frost from penetrating deeply into the ground. It should stand fairly erect, so that it will hold the snow well in winter. It should also be a

plant which can be easily handled in the orchard. In districts where there is danger of making the soil too dry by late growth a cover crop should be chosen which will be killed by early frosts. Among the plants which have been tested as cover crops at Ottawa, are: Crimson Clover, Mammoth Red Clover, Common Red Clover, Alfalfa, Soy Beans, Cow Peas, English Horse Beans, Hairy Vetch, Summer Vetch, Buckwheat and Rape.

"*Soy beans* sown in drills 28 inches apart, at the rate of 37½ pounds per acre, on June 18, made a good growth, but were killed by the first frost, and are hence not satisfactory. Cow peas are too tender.

"*English Horse beans,* sown in drills 28 inches apart, at the rate of one bushel per acre, have done well and continue growing till severe frosts. They hold the snow well in winter as they do not break down easily. They are rolled in the spring and work into the ground easily. Rape, sown broadcast among the Horse beans, makes a good bottom cover.

"*Hairy Vetch* is a good cover crop, making strong growth late in the season. It may be sown broadcast or in drills. It is somewhat difficult to plough under in the spring.

"*Summer Vetch or Tares,*—The Summer Vetch is much cheaper than the Hairy Vetch and is a rapid grower. It should be sown at the rate of about 50 pounds per acre. It kills out in the winter, but furnishes a good cover.

"*Buckwheat.*—This is not a good cover crop, as it adds no plant food to the soil, and the leaves are killed by the first frost, but it is better than nothing and sometimes proves useful for late feed for bees, at the same time helping to hold the snow.

"*Rape* grows rapidly in the autumn and makes a good ground cover. It does not add any plant food to the soil, but is easy to plough under in the spring, as in most places it is killed by winter. Of the non-leguminous plants, or those which do not add nitrogen to the soil, it is one of the best; on the prairies, particularly, this has been found very satisfactory, as with it one is practically sure of a good crop and one that will hold snow well. At Ottawa, rape and tares in the proportion of 6 pounds of the former and 30 pounds of the latter have been sown for a mixed cover crop, the latter furnishing the nitrogen. From 8 to 10 pounds of rape seed alone per acre ensures a good stand.

"*Crimson Clover* has been found too uncertain in the colder districts, the plant not making sufficient growth before winter. In some districts it does well sown at the rate of 10 pounds per acre. Mammoth Red Clover and Common Red Clover, sown about the middle of July and earlier, at the rate of about 12 pounds to the acre, make very good cover crops, the Mammoth Red giving a little the better results.

"*Alfalfa* is not as satisfactory as Mammoth Red Clover, being more exhaustive of soil moisture and more difficult to handle in spring. It has been grown considerably in the irrigated districts of British Columbia recently both as a cover crop and for hay, but the temptation is to irrigate for it to the detriment of the apple trees, hence it is doubtful if it is wise to grow it in orchards there unless irrigation is very carefully done."

Mr. R. H. Helmer, Superintendent of the Dominion Experimental Farm at Summerland, B.C., says in this connection:

"We cannot advise alfalfa indiscriminately as water and depth of soil play a big part in its use, but we can advise that when grown it be used as a mulching crop and not as a hay crop. Do not cut it at all, allow it to rot from year to

year on the land, only ploughing irrigation furrows through it each spring. This is by far the cheapest method of orchard practice, but until alfalfa has been proven successful under various conditions, we would recommend the use of Hairy Vetch."

In this connection it might be mentioned that at the Summerland Experimental Station a system of permanent hairy vetch has been used with excellent results. After sowing the vetch in spring for the first time, it is permitted to grow and ripen seed. As soon as a good quantity of seed pods is ripe, the crop is flattened with a stone boat and disced until it is gradually worked into the soil and a friable surface produced. The seeds which were turned under with the vetch are then permitted to sprout and will soon give a heavy crop of vetch for winter protection, which will start growing in spring and again produce seeds, when the same treatment is given. This system, of course, is only possible on irrigated lands.

Sweet Clover.—Although sweet clover has been in prominence now for some few years as a possible forage crop, its possibilities for orchard use have not been very fully investigated. The whole question is still in the experimental stage, although some Experimental Stations are very favourably impressed with it. Sears of Amherst reports that they think well of its possibilities. He says in part:—

"It is usually necessary to lime the block, if one is to get the best results, and often the first time that you seed down a block you do not get a satisfactory growth, but as soon as you get it once established it will reseed itself if your cultivation is not too thorough, and it has had in our case a very remarkable effect on the growth of the trees. The block where we have tried it out is in our variety orchard so that the trees in the block are several different varieties, but without any exception these trees, growing in the sweet clover block, are very markedly more thrifty, and the leaves a much darker green than on the adjoining blocks with other cover crops."

The objections advanced against its use are (1) the possibility of its becoming troublesome as a weed, (2) that it makes a very inferior growth the first year on poor soils, (3) that, being a biennial, it is liable to make little growth between July 1st and autumn, and that there is a temptation to let it grow in spring and use it for hay. As no data are at hand regarding rate of seeding the same rate as for other clovers, namely about twelve to fifteen pounds per acre, is suggested.

SPRAYING

On the proper carrying out of this operation will depend largely the success of the grower. No matter how healthy and vigorous the orchard, unless it is properly sprayed disaster is sure to come sooner or later. It cannot be urged upon the fruit grower too strongly to give proper attention to this operation in the minutest detail. Recent investigations in the control of orchard pests and fungous diseases have proved conclusively that all these can be controlled profitably. On the other hand they have proved equally as conclusively that a little bit of neglect, ignorance or carelessness will cause the undoing of all the good work done by other operations. Not only is it possible by neglect of spraying to ruin the current crop, but it may also either reduce or entirely eliminate the possibility of a crop the following year. Fungous diseases and insect pests cause a large reduction in the leaf area of the tree thus preventing the proper accumulation of food materials for the formation of fruit buds. Bearing in mind the discussion on page 12 it can readily be seen how imperative it is, therefore, to maintain a healthy, vigorous foliage on an apple tree. As it is impossible to perform a good job of spraying without proper tools the following section is introduced before further discussion takes place:

APPARATUS

The apparatus to be used in spraying will depend to a certain extent on the size of the orchard. But, in any case, a highly efficient outfit is required.

For the large commercial grower the power outfit is necessary, but for the man who has only a small area, say one or two acres, a good hand pump will do. There are many good hand pumps on the market so that one need not purchase a poor one. The hand pump will generally run only one line of hose to good advantage. If a two man pump is used, two lines can be run. Be sure to get a pump which will keep up a good pressure, as this is the the essential point.

For an orchard of five acres or more a power outfit should be used, as with these machines a much higher pressure can be maintained than by the old hand pump. To do a really good job of spraying, a high pressure of 150 to 200 pounds is essential. With this pressure the spray can be driven into the centre of the trees and a much more thorough job done than with the old hand pump, the pressure of which it is hard to keep above 45 to 50 pounds.

POINTS TO CONSIDER IN PURCHASING A POWER SPRAYER

1. *Power and efficiency.*—A two and a half horse-power engine is the most desirable size. An engine of lower horse-power is not entirely satisfactory. The pump should have at least a capacity of seven to nine gallons per minute when the pump is pumping without maintaining pressure but working normally.

2. *Compactness in assembly.*—Some outfits are so geared that the distance between pump and engine is very great, requiring a large number of connecting cogs and wheels, with the result that on rough ground there is considerable apparatus to get out of order. The less gearing in this respect the better.

3. *Pressure.*—The pump and engine should be able to maintain 180 pounds pressure with four regular nozzles running.

4. *Size of tank.*—The tank may vary in size from 150 to 250 gallons; in large, level orchards 250 gallons is to be recommended.

5. *Agitation.*—Some mechanical means of agitation, driven by the engine should be attached. Do not depend on the return hose system. It is not reliable. To get good results in spraying, constant agitation is necessary.

6. *Mounting.*—The whole is better mounted on an iron truck with four and one-half inch tires and high wheels to make the draught easier.

7. *Hose.*—Three-eighths inch hose is giving the best satisfaction. There is less friction in this size of hose than in the one-quarter inch and it is lighter to carry than the one-half inch. In fact, it combines the lowest possible degree of friction compatible with lightness of hose.

8. *Nozzles.*—In selecting nozzles, select a nozzle which gives a fine, broad spray delivered with a good force. In most instances the angle nozzle is preferable to the straight nozzle, for with the angle nozzle the operator can both spray up under the tree and down on to the tree by merely the turning of his rod. The use of the "Y," which will carry two nozzles, is to be recommended. This gives two regular nozzles to each line of hose, enabling the operator to cover his ground much more rapidly. The use of more than two nozzles to a line, however, is not advisable, as spray from each nozzle interferes with the spray from the other, so that when three are used there is liable to be almost a stream in the centre of the zone.

The spray gun, quite recently introduced, is probably a better means of getting the spray where it is wanted than the rod and nozzles. Two of these guns may be used at a time and, as they are adjustable for spraying at both long and short distances, they eliminate the necessity of towers and long rods, and in addition, when used for the drive spray, can reach the centres and tops of trees to better advantage.

HOW OFTEN TO SPRAY

How many sprayings to make is a question which has troubled the grower for many years. Some years the early sprays seem to do the best work, whereas in other years the late sprayings seem to be the effective ones. In the face of all these variations in different seasons, it is necessary to keep the foliage of the trees covered with spray material from the early part of the season until late in the summer. From the results of experiments carried on by this Department in 1913, it seems absolutely necessary to make at least five sprayings to control apple scab effectively in bad seasons.

The importance of the early sprays as an insurance against loss of crop has been neglected and overlooked too much in the past. Not only does the apple scab cause a loss to the grower by impairing the value of the fruit it infests, but is actually destroys a large percentage of his crop before he realizes that it has set. It is the early sprays which save the crop. Some growers delay spraying until after the fruit is supposed to have set, for they claim it is no use to spray if one has no crop to spray for. These men are, in most cases, still waiting for that crop to set. The wise man, however, sprays from the early spring, to make his crop set, and he is now busy preparing for another season.

Apple scab is a disease which spreads or reproduces itself by spores so minute that they cannot be discerned with the naked eye. These small spores are produced by the scabs or spots which are seen on the fruit and which may grow on the leaves as well. Being so prevalent on the leaves they are thus carried over from one year to the next on the old, dead leaves which remain in the orchard. These dead leaves form the source of infection in early spring. When the weather becomes sufficiently warm to start the trees, these spores are liberated from the old leaves and infest the young leaves, reproducing new spores in a very few days. By the time the blossoms are ready to burst, there may be many millions of these spores ready to infest them. At this stage the pistil, which will ultimately ripen into an apple, is very tender and if attacked by the ravages of a germinating spore which sends out roots to penetrate its skin, will be killed and the chances of a crop will thus be ruined. This is how the scab ruins many a crop, and its ravages are often laid down to imperfect pollination or frost. In a large proportion of cases black spot or scab is the true cause of the loss.

It appears that cool, moist weather, such as we have in spring is the most favourable for the development of scab. As it does not do well in hot weather it spreads but little during the late summer, so that the important sprays are the early ones.

Spraying is powerless to cure the disease or repair the damage which has already been done; it can only prevent the development of the germinating spores, so that this must be borne in mind when spraying.

THE FIRST SPRAY

The first spray to make is one just after the leaf buds have opened. This will control the germination of the early spores. This should be followed by another spray made just as the blossom buds are showing pink. This spraying is to be followed by a third, which is to be made just as the petals are falling.

If the period between the time when the buds are pink and when the trees are in full bloom happens to be more than fourteen days, a spraying should be made in between. For instance, in 1913 in Nova Scotia, the blossom buds started to burst very early and were soon in the pink stage. Just after they had burst, a cold, damp spell came on, and they hung in this condition for nearly a month. In fact, there was just a month between the spraying made when the buds were pink and the spraying made when the petals were just falling. This month of cold, wet weather gave the spores a great opportunity and they had obtained such a foothold that the results from spraying were not nearly as good as they would have been had a spraying been made in between the two. Two weeks should be the limit between these sprayings to get the best results. There is so much new surface being formed by the leaves at this period, that, unless the sprayings are made at short intervals the spores will be established on these new, uncoated leaf-portions. This spray made just after the blossoms are falling is followed by another made ten days afterwards. This spray keeps the fungus from infesting and destroying the young apple which is by this time well formed. It in turn is followed by another spray made ten days later. This should in most cases be the last spray necessary. Whether another is to be made or not will depend on weather conditions. If the weather is dry and hot no more spraying will be necessary, but if the weather is cold and damp, another spraying may be required to keep the fungus under control.

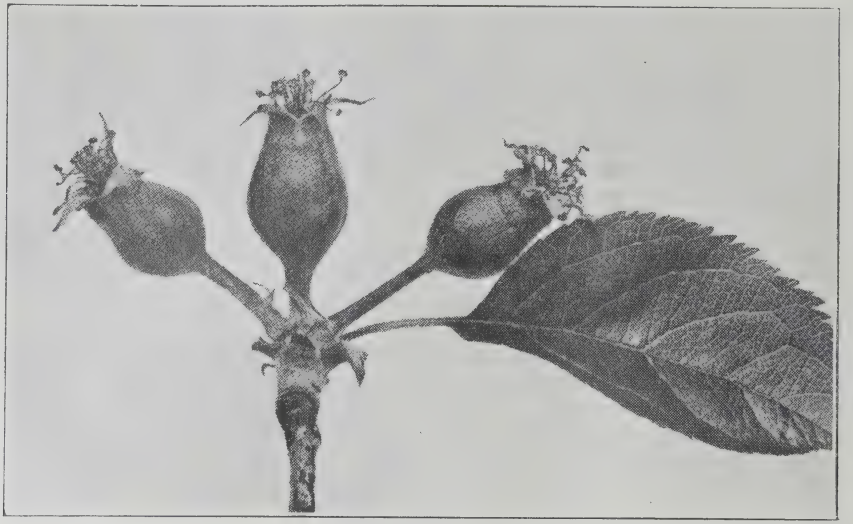
(Kindness of Ontario Department of Agriculture.)
Time to spray for Codling Moth while the calyx is open.

WHICH SPRAY TO USE

There are two important fungicides now in use, viz., lime-sulphur wash and Bordeaux mixture. Both of these are good fungicides and will control apple scab if properly used. The Bordeaux, however, causes a russeting of the fruit in certain sections, which makes it less desirable than the lime-sulphur. Lime-sulphur, on the other hand, when used in the proper dilution, will improve the appearance of the fruit, with no injury to the foliage, and as it controls scab fully as well as Bordeaux, it is to be preferred to that mixture. As these two

mixtures are fungicides it will be necessary to add some arsenical poison to control biting insects and, in some instances, the addition of a contact insecticide for the control of sucking insects may be required.

The two most commonly used and most desirable forms of arsenic for orchard use are arsenate of lead and arsenate of lime, sometimes called calcium



(Kindness of Ontario Department of Agriculture.)
Calyx is closing, it will soon be too late to spray for the Codling Moth.

(Kindness of Ontario Department of Agriculture.)
Calyx is closed. Too late for the Codling Moth spray.

arsenate. These two poisons are sold in both the powdered and paste forms but it is usually more economical to use the powdered form in both cases, owing to less bulk entailing a lower freight rate and making possible a cheaper package.

The calcium arsenate is somewhat cheaper to use than lead arsenate and may be used satisfactorly with either Bordeaux or lime-sulphur. In the latter

case, an addition of two to three pounds of hydrated lime (builder's lime) is recommended. Lead arsenate, when used with lime-sulphur, causes somewhat of a disintegration of that product, forming a black sludge. This may be partially overcome by the previous addition of three or four pounds of hydrated lime. on the whole, however, the use of arsenate of lime is generally recommended.

As a contact spray which can be combined with the fungicides and other insecticides, sulphate of nicotine, sold under various trade names, is the one universally adopted and giving satisfaction.

STRENGTHS TO USE

The argument has been advanced that lime-sulphur used at previously recommended strengths caused injury to leaf and young blossom buds and that the 4-4-40 Bordeaux caused extreme russeting. In the first instance, the now recommended strengths of lime-sulphur are somewhat more dilute than previously and the Bordeaux formula has been altered to some extent. The recommendations in the spray calendar (see page 41) are based on the findings of recent experimental work.

The argument is still advanced in some sections that lime-sulphur causes an injury to the young blossom buds, thereby lessening the set of fruit. In other districts the claim is made that what is known as Bordeaux injury, namely russeting, is almost as bad as an attack of scab. It has been the observation of the Central Farm, and of the Branch Experimental Farms and Stations, that Bordeaux does cause considerable russeting, whereas lime-sulphur gives, as previously mentioned, a better finish to the fruit. Observations and counts have likewise failed to substantiate the claim that lime-sulphur reduces the crop by "spraying off the young apples," when used acccording to modern recommendations. On the whole, therefore, our recommendations are still in favour of the continuance of the lime-sulphur sprays, although the Bordeaux formula and recommendations are given as alternatives to those who may desire to use them.

DOES IT PAY TO SPRAY?

Actual Bona Fide Results will Tell.

In some spraying experiments carried on by the Experimental Station at Kentville, N.S., some excellent results were obtained in showing the value of spraying.

The check plot which was not sprayed at all gave a yield of one-half bushel per tree, of 97 per cent scabby apples. The plot sprayed with lime-sulphur and arsenate of lead gave 3.2 bushels per tree of 17 per cent scabby fruit, a difference of 2.7 bushels per tree in yield in favour of the sprayed plot, and a difference in scab of 80 per cent in favour of the sprayed plot.

The trees were of the King of Tompkins variety, and although yielding rather lightly, yet the crop from the sprayed plot was very profitable. From ten trees in each plot the financial returns were as follows:—

Sprayed (10 trees) gave a gross receipt of..	$25 97
Cost of spraying..	7 00
Net returns..	$18 97
Unsprayed (10 trees) gross receipt..	$ 2 37
Difference is net receipts in favour of the sprayed plot..	16 60

Homemade Lime-sulphur

The formula which has given the best results in the home manufacture of lime-sulphur is the one given below:—

Lime	50 pounds
Sulphur	100 "
Water	40 gallons

Put about 10 gallons of water in the tank and add the lime. As soon as slaking is well under way, add a portion of the sulphur (about one-half) and stir for a few minutes, then add the rest of the sulphur and the rest of the water, stirring continuously. Allow this to cook for an hour, keeping it well stirred until the sulphur scum has disappeared. At the end of one hour, if it has boiled sufficiently, the sulphur and lime should be in solution and the mixture should be a dark, clear, brick red. If it presents a pale, muddy appearance it needs more boiling.

During the process of cooking, some of the water will evaporate, so at the start it is necessary to add more water than will be required at the end. A good measuring stick should be used, and marked at different places to show the point at which the tank contains 40, 45 and 50 gallons.

The operator can soon determine after a boiling or two just how much extra water is needed at the start, and by using the measuring stick he can tell when he has boiled his solution down to the required strength.

As soon as the liquid reaches the clear, brick-red stage, the fire should be removed and the liquid strained into barrels. The strength should be between 1.25 and 1.28 specific gravity if it has been properly made. When it has become cool is the time to determine its strength, and the strength of each barrel should be marked on it in plain figures. (Use the hydrometer.) A hydrometer is indispensable when using lime-sulphur and a few words regarding its use are here given.

The hydrometer is an instrument which is used to determine the specific gravity of the mixture, and, knowing this, the operator is able to determine the number of dilutions necessary for his different sprayings. To determine the number of dilutions it is necessary to make with a certain barrel of lime-sulphur, divide the decimal of the concentrate by the decimal of the strength required, and the result will tell the number of times necessary to dilute the concentrate to get a mixture of the desired strength. Example: Given a barrel of lime-sulphur concentrate testing 1.27 specific gravity, it is desired to make the second spray which requires a lime-sulphur solution of 1.01 specific gravity; how many dilutions are necessary? Divide the decimal of the concentrate, .27, by the decimal of the dilution desired, .01, the result is 27. Therefore 27 is the number of dilutions necessary. That is, to every 27 gallons of water use one gallon of this particular lime-sulphur solution.

The cost of making lime-sulphur is very small after the operator has his equipment. The actual cost of making the lime-sulphur would be:—(1914 prices).

100 pounds sulphur at 2c	$2 00
50 " lime	25
Total for material	$2 25
Labour	75
	$3 00

The use of commercial lime sulphur has practically superseded the home-made article, as it is much simpler and easier for the orchardist. In using the commercial product a hydrometer is not necessary, as the commercial concentrated solution is quite constant in strength and can be mixed according to definite formulae. The spray calendar attached to this bulletin gives the different strengths of lime sulphur recommended for the different sprays.

DUSTING

The practice of dusting instead of spraying has been quite largely adopted in recent years and has its many advocates.

Dusting has certain advantages over spraying, which will be referred to shortly, but it has never yet been fully demonstrated that applications of dust are able fully to cope with the scab problem in seasons of frequent infestations, whereas an adhesive spray mixture has been proved to give good results. As an adjunct to the spray outfit in large orchards it has proved its fitness, but as a substitute entirely, it is not to be recommended. The advantages of dusting over spraying are mainly three: speed in application, lowering of total cost, and as being less laborious and more cleanly for the operator. The objections, according to the tests at this Farm, are briefly summarized below:—

In order that dust can be made to adhere to the foliage (without adherence it is useless as a fungicide) the leaves must be ladened with dew or moisture. This makes it necessary to apply dust before the dew is off in the morning, or after it has fallen at night, limiting the time of application to a comparatively short period in the day. It furthermore requires that there be a dew at the time when applications are to be made and this has been the greatest difficulty at this Station. During this past season, at the time of the third spray, there were six successive days when there was not enough dew to cause the dust to stick sufficiently long, so that an examination made twenty-four hours later could show signs of the trees having been treated. Under such circumstances dusting, as at present practised, is a very poor substitute for the spray outfit.

For those who may desire to utilize a duster as an adjunct to their spray outfit, it is recommended that application be made to the Publications Branch, Department of Agriculture, Ottawa, Ont., for literature on the formulae recommended from time to time, as such formulae are so unstable that it is hardly advisable to embody them in a bulletin which will remain in print for some years.

THINNING.

Thinning fruit is a practice which has not become very widespread throughout Eastern Canada as yet. If the growers, however, were really alive to their opportunities much more thinning would be carried on in the future.

In thinning, those apples which are spotted or deformed are removed, and in cases where there are too many apples in a cluster, the poorer ones are removed, thus giving the remaining fruit a better chance to reach maturity and go into the No. 1 barrel.

The distance apart to leave the fruit is a matter of considerable controversy. A good, safe plan, however, is to thin so that no two apples will be touching each other or will be on the same cluster. Thinning experiments were carried on by the Experimental Station at Kentville, N.S., on their demonstration orchards, and excellent results were obtained. The apples thinned were the Blenheim Pippin. The apples were removed from the trees about the middle of July. The apples were all counted and records kept of the same. The fruit was thinned to one apple to the cluster; besides this, all spotted and ill-shaped apples were removed.

In the fall when the fruit was picked, the apples were counted as they were removed from the trees and the results were as follows:—

Number of trees unthinned	7
Number of barrels picked	37
Number of apples picked in the fall	24,014
Average number apples per barrel	649
Number of trees thinned	5
Number of apples removed in summer	2,099
Number of apples picked in fall	10,426
Total number on tree	12,525
Number of barrels tree run in fall	19
Average number of apples per barrel	549

Now had these trees not been thinned, the size of the apple would have remained the same as the size of the fruit on the unthinned trees, or 649 apples per barrel. This would have given a total yield in the fall of 19 barrels, which is exactly what was received, even after thinning, so that it is evident there was no decrease in bulk due to the thinning. The increased size of the apples remaining on the trees made up for the apples removed. When these apples were packed, the results of the pack out were in favour of the thinned plot and were as follows:—

	Thinned	Unthinned
Per cent No. 1	58.0	32.3
" No. 2	21.0	23.0
" No. 3	14.6	25.7
" Culls	None	12.5
" Slack	6.4	6.5

It will be noticed that the percentage of No. 1 apples is much greater from the thinned trees.

These apples were shipped to the English market, each lot being separate. The unthinned fruit was branded with ABF as a shipping mark, while the thinned fruit was branded MBD. They were sold on their merits only, the consignee not knowing there was any differecne in the lots except from what he could observe in reward to quality.

The sales returns were:—

	Unthinned	Thinned
No. 1 per barrel	$1 67	$2 01
No. 2 "	1 67	1 66
No. 3 "	74	74

It will be noticed that the No. 1 apples from the thinned trees brought 34 cents per barrel more than the apples from the unthinned trees. With these figures the following results appear interesting when using 100 barrels tree run in each case as a basis to work on.

	Unthinned		
	No. of barrels	Value	Total
No. 1	32.3	$1 67	$ 53 94
No. 2	23.0	1 67	38 41
No. 3	25.7	74	19 01
Culls	12.5	30	3 75
Slack	6.5	....	....
Total proceeds			$115 11

	Thinned		
	No. of barrels	Value	Total
No. 1	58.0	$2 01	$116 58
No. 2	21.0	1 66	34.86
No. 3	14.6	74	10 80
Slack	6.4	....	....
Total proceeds			$162 24
Loss on 100 barrels due to not thinning			$ 47 13
Cost of thinning (actual cost)			5 00
Net loss due to not thinning			$ 42 13

The only conclusion that can be drawn from the above is that where the trees are at all loaded it pays to thin. In the case of such apples as the Baldwin, which produce heavily every other year, moderately large crops can be obtained every year if thinning is practised to some extent.

THE RENOVATION OF THE NEGLECTED ORCHARD

Throughout the different provinces of Canada are to be found orchards, old and young, which have for some years been sadly neglected and abandoned. In many instances these neglected orchards are still capable of producing very profitable crops if the proper steps are taken to bring them back to condition.

In old orchards, which have been neglected, there will probably be very little new wood so that the first thing in mind will be to make the tree produce as much new wood as possible. As pruning in the spring of the year, say early in March, is conducive to wood growth, this is considered the best time to start that operation in the old, neglected orchard.

The first thing to do is to remove all dead and broken branches and all parts which are infested with canker or other diseases. Too much stress cannot be laid on the necessity of removing all canker-infested limbs, and in removing them cut well back into the good new wood. Afterwards, all this brush should be immediately burned, for if it is not destroyed it only forms a source of infection for the remaining healthy limbs.

Having removed all dead and diseased wood, it now remains to attempt to shape the tree into some desirable form. Many of these old trees only bear leaves and fruit spurs on the outside tips of the limbs, the remainder being destitute of both foliage and fruit. If this condition were to remain, the actual bearing surface of the tree would be so small that profitable crops would be an impossibility. In order, then, to induce new shoots to grow from the lower parts of the branches a vigorous method of heading in or of "dehorning" must be adopted.

In cases where the trees are thirty feet or over, the top should be cut back all round, so that afterwards the tree will be about eighteen feet in height. This "dehorning" will induce a more spreading form of tree. In cutting, cut back to a healthy sprout or spur, and if the tree is too tall and not spreading enough, see that the spur that is cut back to is pointed outwards. On the other hand, if one is dealing with a tree which is too spreading, cut the lateral limbs back to a spur which is pointing upwards. In this way the shapes of the various trees may be modified to a large extent.

"DEHORNING"

The great possibilities of transforming these old barren trees into profitable bearers have not impressed themselves on a very large number of growers. Some excellent examples however, are to be found in the Niagara district, and a few photos of some of these examples are contained in these pages.

Removing such large quantities of wood as eight to ten feet would, of course, tend to make the tree throw out new sucker growths from all parts, although most of the growth will come from near the cuts. These suckers, by proper selection, can be used to form a new framework to the tree, thus giving practically a new tree. Suckers will not only spring from near the cuts, but will also arise from the lower parts of the tree, thus giving an opportunity to select the strongest to form branches. By selecting the most favourably located of these suckers and by cutting them back, say, one-third, they will be induced to give forth laterals so that in a very few years a complete transformation can be made by use of these water sprouts.

It may so happen that the grower, if he were to remove about ten feet from the height of his tree in one year, would not have sufficient foliage bearing wood left to carry on the work of the tree. In this case, it would be advisable to remove only about five feet the first year, and in about two years' time, after the new sucker growth had become well enough established to carry on the work of the tree, the remaining five feet could be removed without any undue injury.

In distinct contrast to the poor, thin, old tree is the tree which is full of water sprouts and dense masses of wood. This latter tree is not so difficult to bring back into shape, for we have something more to work with. In this case a number of the water sprouts are removed entirely and the best selected to form the central framework of the tree. In these thick or bushy trees a large amount of brush must be removed in order to admit sunlight and air. In cases where very large amounts of wood must be removed, it might probably be better to remove only the dead and diseased wood the first year, then the second year complete the operation. In the case of very tall trees which are to be dehorned, the same principle should be followed, that is remove about six feet per year until the branches are shortened to the desired length.

Partially "dehorned" Baldwin trees in the orchard of Jos. Tweddle, Stoney Creek, Ont. Next year these trees can safely have the remaining five or six feet removed from the top, which will bring them down to the required height. Only about six feet was removed at the first "dehorning."

RESULTS OF DEHORNING

The results obtained from "dehorning" two orchards in the Niagara district are very interesting indeed. One of the two orchards was that of Mr. Jos. Tweddle at Stoney Creek. Here were found Baldwins, Greenings and Spys all dehorned. They had been dehorned for two years and showed no signs of rotting at the cuts, except in one or two cases where the cuts were carelessly made by the pruner. In some cases Mr. Tweddle had painted the wounds and in other cases he had not. Although no rot was apparent in the unpainted cuts yet it seemed advisable to paint all wounds to keep out the weather and any possible infection from fungous diseases.

In the case of the Spys, some eight to ten feet had been removed and the results obtained were very satisfactory. Mr. Tweddle plans to dehorn during the year when he expects a full crop, so that the trees will not be inclined to put out too much sucker growth. In the Spys, the sucker growth is not overabundant, but yet sufficient to give a large amount of new wood to select a new frame from.

Probably the most interesting was his Baldwin orchard. Here were trees which, two years previous to treatment, had very little brush on them, and what they did have was located on the tips of long branches, giving the tree the appearance of an old paint brush. In this orchard five to six feet only could be removed the first year, for if more had been taken there would not have been enough foliage to carry on the work of the tree. Two years after treatment a great change had taken place. The old trees were practically rejuvenated. The result of the dehorning was that the trees put out a very vigorous growth of suckers, both on the tips of the branches and also well down to the main trunk. By selecting the best of these Mr. Tweddle formed practically a new tree, and the next year was able to take five feet more off the top, bringing his trees down to the desired height. He will have changed old tall trees with foliage only on the tips into moderately high, spreading trees with bearing wood and foliage from the tips back to the main trunk.

Showing excellent use of suckers or water sprouts. Note the large healthy water sprouts in the centre of No. 2. These will in a few years become large and branching enough to allow of the removal of some of the large top. Compare the large tree in the center (No. 1) with its water sprouts, to the one on the left (No. 2) with its barren centre.

In the case of the Baldwins, the amount of sucker growth is perhaps a trifle too much. This is due no doubt to the fact that, owing to weather conditions, the crop was very light the year he dehorned instead of being heavy as he expected. This of course, gave the trees a tendency to put out a large amount of sucker growth.

In another orchard, viz., that of Mr. W. H. Bunting, are to be found Kings, Baldwins and Greenings all dehorned with excellent results, although the Baldwins in some cases have thrown out very large amounts of sucker growth.

THINNING OUT OF TREES.

In many cases old orchards will be found to be so closely planted that to prune them or head them back sufficiently to enable one to work among the trees, would mean that practically the tree would be demolished. In such cases

it is more profitable to remove some of the trees, probably every other one. This gives an opportunity for the remaining trees to develop into profitable bearers, whereas if they were allowed to remain thick, although there would be a greater number of trees, they would not yield as much as the lesser number of trees.

Where trees are so thick, it is impossible to spray properly, and hence either no crop at all or at least a very inferior one is the result, so that to remove some of the trees, although it may seem a drastic measure, is really the most profitable scheme.

If the orchard is planted on the diagonal plan, the tree in the centre of the square can be removed. In fact this is the only proper course of thinning that can be followed out in such a plantation.

If planted on the square, however, every other tree can be removed, leaving the rows running diagonally across the orchard. In this case it would be best to make a plan of the orchard on paper, marking all missing trees and all unde-

"Dehorned" Baldwin trees in the orchard of Mr. W. H. Bunting at St. Catharines, Ont. Too much sucker growth. Large quantities of these should be removed. An excellent new frame can be made by selecting these suckers. The value of these water sprouts is very great. This extreme suckering is due to "dehorning" in a year when the Baldwins were not bearing heavily.

sirable trees. Then work out the plan of thinning which will take in the largest number of undersirable and missing trees; for instance, one may start by leaving the first tree in the first row, or start by taking out this tree. In each case one removed, and instead of removing them entirely at once, head them back matter is planned out on paper, one might remove a larger number of good, desirable trees than is necessary.

A good system to adopt is to make out this plan, select the trees to be removed, and instead of removing them entirely at once, head them back or thin them out vigorously, giving the trees which are to remain more room. This can be carried on year by year until the trees which are eventually to be removed will practically be demolished by the sucessive thinnings. This gives the grower some crop off these trees while the remaining trees are getting ready to fill in the spaces.

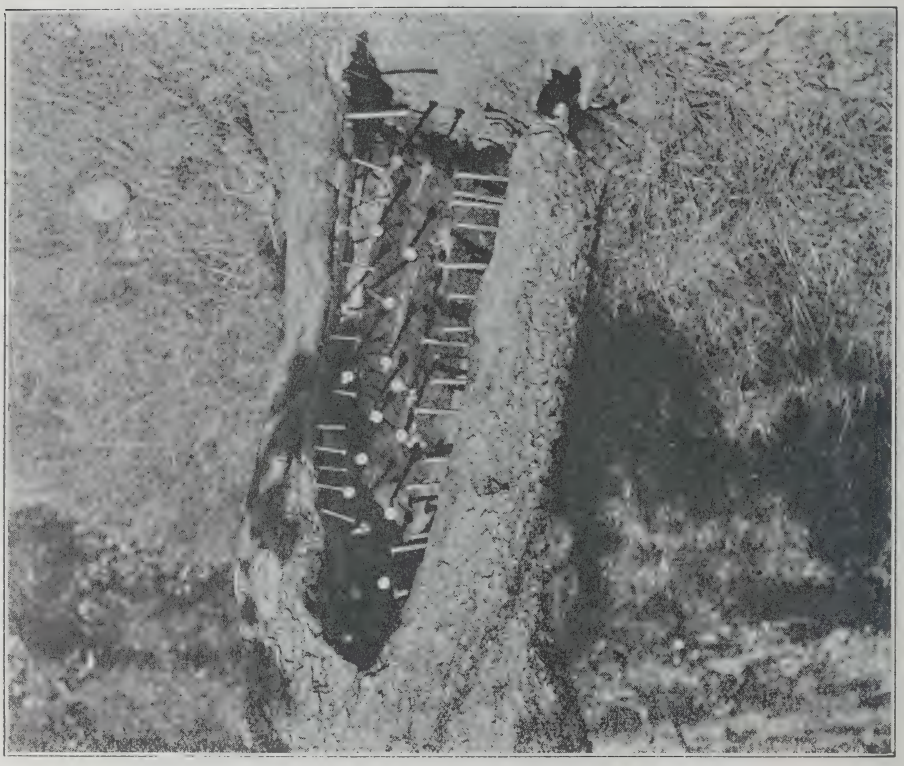
At this juncture it might be interesting to correlate this treatment with our knowledge of plant nutrition as described on page 12. In the neglected, non-bearing orchards, which are making little or no growth, the condition of excessive carbohydrates as compared to nitrates exists, so that by a reduction of the top the balance between these two is more or less re-established. The operations of ploughing and cultivating, will also tend to increase soil nitrification and thus further assist in the correction of the balance. Whether or not nitrates should

(Courtesy of Agricultural Experimental Station, Storrs, Conn.)
The result of leaving large wounds unprotected. Trees like this are scarcely worth renovating.

be used in addition, during the first year, is a question the answer for which depends upon the amount of wood removed. If considerable top is removed and nitrates added in addition there is danger of maintaining too high a nitrate content late into the season with resultant late growth, unripened wood and severe winter injury. On the other hand, if only a small amount of top is removed, some nitrate may be safely applied. Caution and good judgment are required in the application of these treatments.

SCRAPING, CLEANING AND TREE SURGERY.

In many instances there will be cases of split crotches to mend and dead parts to be removed, which will leave holes or areas for further trouble if not cared for. If a split crotch is in evidence, it may be bolted together and the crevice which is left should be filled in with grafting wax or cement to keep out all diseases such as canker. If there is a side of a large branch which has a hole in it, this should also be filled in with cement. Wherever the bark has been seriously broken and removed, this place should be cared for in somewhat the same way.



Showing Large Cavity Cleaned Out and Nailed Ready for Filling.

Sometimes it is noticed that a tree is dead on one side from collar rot, while the other half is in perfect condition. If there are suckers growing at the base, this tree can be saved by bridge grafting the suckers into the healthy portion of the tree. These suckers, being on good, healthy roots, will soon increase in size, and probably by the time the tree is completely girdled these new roots will be able to take care of the old top, and the tree will thus be saved. Many instances of saving trees in this manner may be cited.

If the trees are covered with old moss and scurfy bark, they should be scraped. A short-handled hoe, well sharpened, will do admirably for this work. They may be scraped in early spring. This scraping removes all loose bark and hence leaves fewer crevices for scale insects and other diseases to get a foothold in.

During the growing season of 1919 some experimental work in tree surgery was undertaken at the Central Farm. The winter of 1917-18 had done considerable damage to many of the trees in the orchard, which left them in a condition requiring immediate attention.

Wherever possible, an attempt was made to save a tree and prevent any further decay, different mixtures and methods being used for filling the cavities after they had been cleaned out.

In all cases, cavities were cleaned out thoroughly by removing all decayed and decaying wood with chisels. After all this material had been cleaned out of the wound, it was then disinfected with corrosive sublimate, one part to five hundred of water, followed by an application of creosote. Care was taken to prevent either the sublimate or the creosote from coming into contact with the living tissue surrounding the wound.

Showing Cavity being Filled by Brick Method.

After the disinfection of the cavity, nails were driven in for the purpose of holding the filling.

Two methods of filling wounds were adopted. The first was what is called the brick method and is illustrated above.

This method consists of placing the mixture in the wound in layers, and between each layer is placed a sheet of roofing paper. For large cavities, such as illustrated, this is recommended, as it allows for a certain amount of movement when the tree is racked by the wind and tends to prevent cracking of the mixture.

The second method was simply to fill the cavity with the mixture in one solid block.

For filling the cavities, cement mixed in the proportions as set forth in the following table was used:—

Mixtures for Tree Filling

Mixture Used	Remarks based on notes taken in early part of 1921
Cement, 2 to 1 mixture, no waterproofing	Considerable cracking, mixture too rich in cement.
3 to 1 cement, no waterproofing	Perfect condition, no cracking.
4 to 1 cement, no waterproofing	Perfect condition, no cracking.
2 to 1 cement and plaster mixture	Composition crumbling, of no value.
3 to 1 cement and plaster mixture	Badly cracked, crumbling.
3 to 1 cement and waterproofing, 1 pt. to 5 gal	All in first-class shape except one large one done by solid mass method, which should have been bricked.
2 to 1 cement, waterproofed by painting after set	Some cracked, some in good condition.

Recommendations

From the results of this experiment to date certain recommendations may be made.

The cavities should all be thoroughly cleaned out and all decayed or decaying wood removed. A strong disinfectant, such as corrosive sublimate, 1 to 500, or creosote, or both, should then be applied to the cavity, taking care that neither of these solutions comes into contact with the living bark surrounding the cavity.

After disinfection, the cavity should be filled with nails as illustrated, the size of the nails to be used depending upon the size of the cavity, generally a $2\frac{1}{2}$ nail is best suited. The bark surrounding the cavity should then be cut back to living tissue in order to give the wound an opportunity of healing over.

The cavity is then ready for filling. From our experience, a 3 to 1 mixture of cement and very fine gravel is the best; that is, three parts of very fine gravel to one of cement mixed with sufficient water to form a grout of such consistency as will just fall off the end of a trowel without running. If the cavity is a long vertical one, the brick method of filling should be used. If just a small or local crotch cavity, the solid mass method will suffice.

After packing the cavity with the mixture, the outer surface should be smoothed and care taken that the filling does not protrude so far beyond the outer circumference of the wood of the tree as to prevent the bark from growing over it when the wound commences to heal. If no attention is paid to this, the growing bark will press against the mass and either split the tree or crack the cement, This is a common cause of poor results in tree surgery.

The final step is to wrap wet sacking around the filling for a few days until the mass is well set, after which the sacking may be removed without danger of the composition drying out too quickly, with resultant cracking.

Waterproofing.—Apparently it is not necessary either to mix waterproofing with the cement or to paint it over with a waterproofing after it has set. In fact, when waterproofing was mixed with the cement it appeared to lessen its resistance to freezing and thawing.

SPRAY CALENDAR

Plant	1st application	2nd application	3rd application	4th application
APPLE To control scab, sooty blotch, black rot, codling moth, leaf-eating caterpillars, borers, blister mites, curculio, apple aphis, scale insects.	Just as leaf buds open. Lime-sulphur 1–40, arsenate of lime 1 lb. to 40 gal., 2 to 3 lb. hydrated lime; or 4–8–40 Bordeaux and 1 lb. arsenate of lime.	Just before blossoms open. Lime-sulphur 1–45, arsenate of lime 1lb. to 40 gal., 2 to 3 lb. hydrated lime; or 4–8–40 Bordeaux and 1lb. arsenate of lime.	As soon as blossoms fall. Lime-sulphur 1–50, arsenate of lime 1lb. to 40 gal., 2 to 3 lb. hydrated lime. Bordeaux is not recommended for this or later sprays on account of russeting. An alternative of soluble sulphur or polysulphides may be used as follows : 1 qt. sulfocide or 1 lb. soluble sulphur, 5 lb. hydrated lime, ½ lb. arsenate of lime, 40 gal. water.	A fourth spray may be made two weeks later than the third, when scab is liable to be difficult to control.

Nicotine sulphate, Kerosene emulsion or Whale-oil soap, just when buds break and eggs are hatched, for aphis; again late in May or June when young scale insects hatch.

NOTE.—Nicotine sulphate may be used in conjunction with Lime-sulphur or Bordeaux mixture.

For oyster-shell scale, spray trees late in autumn with lime-wash, two coats, applying the second as soon as the first is dry.

CHERRY Rot, leaf diseases and injurious insects. Cut out and burn Black Knot six inches below affected part whenever seen.	Poisoned lime-sulphur or poisoned Bordeaux Before flower buds open. Kerosene emulsion or whale-oil soap solution for aphis.	Poisoned Bordeaux or poisoned lime-sulphur, when fruit has set. (*Important*)	Poisoned Bordeaux or poisoned lime-sulphur, 10 to 15 days later. (*Important*)
	If a late brood of the cherry or pear slug appears, spray with arsenate of lead or Paris green.		

Plant	1st application	2nd application	3rd application
PEAR Scab, cracking, leaf blight, codling moth, blister mite, "slug," pear pyslla.	Copper sulphate. Before buds start. (*Important*)	Poisoned Bordeaux. Just before blossoms open. (*Important*)	Poisoned Bordeaux. Soon after blossoms fall. (*Important*) If disease is showing, spray 10–12 days later and again in two weeks.
	For pear psylla, kerosene emulsion or whale-oil soap just after leaves expand, and again in a week. If late brood of "slug" appears, use arsenate of lead or Paris green.		
PLUM Rot, scab or blight, shot-hole, bud moth, curculio, aphis. Cut out and burn Black Knot six inches below affected part.	Lime-sulphur wash or copper sulphate and arsenate of lead or Paris green. Before buds open. (*Important*)	Lime-sulphur wash (1-40) or poisoned Bordeaux (3-4-40). Very soon after blossoms have fallen. (*Important*) For curculio.	Lime-sulphur (1-40) or poisoned Bordeaux (3-4-40 12-15 days later and again in about two weeks. Kerosene emulsion or whale-oil soap for aphis, or nicotine sulphate may be added to the lime sulphur or the Bordeaux.

INSECTICIDES.

Internal Poisons (For Biting Insects)

Paris Green

Paris green	1 lb.
Unslaked lime	1 lb.
Water	160 gal.

Arsenate of Lead

Arsenate of lead	1-1½ lb. (powder)
Water	40 gallons

Mix thoroughly before using.

Arsenate of Lime

Arsenate of lime	1-1½ lb. (powder)
Hydrated lime	3 lb.
Water	40 gallons

This is cheaper and now more generally used than arsenate of lead.

Nicotine Sulphate

(Containing at least 40 per cent nicotine (For Aphis.)

Nicotine sulphate	1 oz.
Water	6¼ gal.

or 1 part to 800 to 1,000 of water.

It should be more concentrated for some species.

Nicotine (For Rose Thrip and Aphis)

Nicotine	1 teaspoonful
Water	1 gallon

Kerosene Emulsion (For Aphis, Scale and other sucking insects)

Kerosene (coal oil)	2 gallons
Rain water	1 gallon
Soap	½ lb.

Dissolve soap in water by boiling; take from fire and while hot, turn in kerosene and churn briskly for 5 minutes. For use, dilute with 9 parts of water so that the above 3 gallons of stock emulsion will make 30 gallons of spraying mixture.

Flour Emulsion (For Aphis, scale and other sucking insects)

Kerosene	1 qt.
Flour	8 oz.
Water	2 gallons

Stir together the flour and kerosene, then add the water and churn violently for five minutes. To be used at once.

Whale-Oil Soap

For brown or black aphis	1 lb. in 4 gallons water
For scale insects (young)	1 lb. in 5 gallons water
For green aphis or thrip	1 lb. in 6 gallons water

Tobacco and Soap-Wash. (For aphis and other sucking insects)

Soak in hot water for a few hours 10 pounds of tobacco leaves (home-grown will do); strain off and add 2 pounds of whale-oil soap. Stir until all is dissolved, and dilute to 40 gallons. Apply early and two or three times at short intervals.

Lime Wash (For Oyster Shell Scale)

Unslaked lime	1 to 2 lb.
Water	1 gallon

Strain through sacking before spraying. To be applied late in autumn.

Lime-Sulphur Wash (For San Jose Scale and Fungous Diseases)

Lime	20 lb.
Sulphur, powdered	15 lb.
Water to make	40 gallons

Slake the lime with only enough water to do it thoroughly. Add the sulphur by dusting it over the lime while slaking; stir well and boil for at least an hour, adding only so much hot water as is necessary for easy stirring. When thoroughly cooked, strain through sacking and apply hot.

Commercial Lime Sulphur

When commercial concentrated lime sulphur wash is used, it should be diluted for use, when there are no leaves on the trees, to 1 gallon of the concentrated wash to about 9 gallons of water varying with the intensity of the wash. For use when there is foliage the lime-sulphur should be diluted to 1 gallon of the concentrated wash to 40 to 50 gallons of water. Arsenate of lime is the best poison to use with the lime-sulphur wash, but it is advisable to add two or three pounds of hydrated lime to every forty gallons.

Concentrated Lime Sulphur

This can be made at home instead of buying the commercial lime sulphur. With a formula of 50 pounds fresh lime, 100 pounds sulphur to 40 gallons of water. Heat the water to near boiling, then put in the lime and when it is slaked, add the sulphur, having first broken any lumps and screened it. Keep the mixture boiling well for an hour when, if it has been frequently stirred, it should be in condition. Then replace water lost in boiling to make up forty gallons. Strain through a 20 to the inch mesh and store in barrels until needed. If barrels are not closed, covering the surface with oil will prevent evaporation. This is usually a little weaker than the commercial washes.

Use of the Hydrometer in Determining Proper Dilution of Concentrated Lime Sulphur

The hydrometer which can be obtained from most druggists with specific gravity readings, is a small instrument costing about $1, which it is very desirable to use when lime sulphur is used as a summer spray, as different concentrated solutions vary somewhat in strength, and in dealing with tender foliage it is very essential to be sure of the strength one is using. To test the strength of the solution with the hydrometer, the latter is put in it when it is cool and any sediment has gone to the bottom, and the reading noted. The reading will indicate the density of the concentrate. To obtain the total dilution required, the decimal of the reading of the concentrate is divided by the decimal of the strength required. For summer strength the reading should be 1.009 to 1.01.

Self-Boiled Lime Sulphur (Especially for Brown Rot Affecting Peaches)

Unslaked lime	8 lb.
Sulphur (flour or flowers)	8 lb.
Water	40 gallons.

Slake the lime in a barrel with a little cold water. After screening to break up lumps, put the sulphur in another vessel and add enough water to make a thin paste. Now pour the sulphur paste, or even the dry sulphur, slowly into the barrel containing the slaking lime. Stir the mass thoroughly and add enough cold water to keep the lime from sticking to the bottom of the barrel and to ensure thorough slaking, but avoid using more water than is necessary until the lime is slaked, when enough water should be at once added to cool the mass. Strain before spraying and add enough water to make up to the proportion in the formula. It is found that a desirable amount of heat is obtained by slaking 24 pounds of lime with 24 pounds sulphur at one time.

Alkaline Wash (For Borers)

Soft soap reduced to the consistency of thick paint by the addition of a strong solution of washing soda in water. If applied with a brush about the 1st July on the morning of a warm day, this will dry in a few hours and form a tenacious coating not easily dissolved by rain. If 1 pint of crude carbolic acid to the gallon of wash be added, it will make it more effective.

FUNGICIDES

Bordeaux Mixture (For Fungi)

Copper sulphate (Bluestone)	4 lb.
Unslaked lime	8 lb.
Water (1 barrel)	40 gallons

When spraying peach and plum foliage which may be injured by the ordinary formula, it is safer to use Bordeaux mixture in the proportion of 3 pounds copper sulphate, 4 pounds lime to 40 gallons water.

Dissolve the copper sulphate (by suspending it in a wooden or earthen vessel containing 4 or 5 or more gallons of water.) It will dissolve more quickly in warm water than in cold. Slake the lime in another vessel. If the lime,

when slaked, is lumpy or granular, it should be strained through coarse sacking or a fine sieve. Pour the copper sulphate solution into a barrel, or it may be dissolved in this in the first place; half fill the barrel with water; dilute the slaked lime to half a barrel of water, and pour into the diluted copper sulphate solution, then stir thoroughly. It is then ready for use. (Never mix concentrated milk of lime and copper solution.)

A stock solution of copper sulphate and milk of lime may be prepared and kept in separate covered barrels throughout the spraying season. The quantities of copper sulphate, lime and water should be carefully noted. Bordeaux mixture deteriorates with age and should be used as soon as made.

To test Bordeaux mixture, let a drop of ferrocyanide of potassium solution fall into the mixture when ready. If the mixture turns reddish-brown, add more milk of lime until no change takes place.

Poisoned Bordeaux Mixture (For Fungi and leaf-eating insects)

To the 40 gallons of Bordeaux mixture prepared as above, add 1 to 1½ pounds of arsenate of lime, or 1 to 1½ pounds of arsenate of lead. Four to eight ounces of Paris green may be used if arsenate of lime and arsenate of lead are unobtainable.

Resin Sticker

Resin	8 lb.
Washing soda (Sal. soda, Carbonate of soda)	4 lb.
Water	4 gallons

Dissolve 4 pounds of washing soda in 4 gallons of hot water and then bring the solution to a boil. In another vessel melt 8 pounds resin. When the latter is melted, pour it slowly into the boiling soda solution until all the resin is added, stirring it well at the same time. After all the resin is added, continue boiling for one hour or until a homogeneous mixture is obtained. If properly made, this will mix well with water or Bordeaux mixture. As some water will be evaporated in boiling, sufficient should be added to make the stock mixture 4 gallons.

Two quarts of the above stock mixture should be used with 40 gallons of Bordeaux mixture.

Resin sticker may be added to Bordeaux mixture (2 quarts to 40 gallons) and makes it adhere better to foliage.

N.B.—All the above recommendations are dependent on weather. If heavy rain falls immediately after spraying, applications should be repeated, but spraying shortly before rain is better than spraying after rain.

Always wash out thoroughly with clean water all pumps and nozzles immediately after using. The gallon referred to above is the Imperial gallon.

Several different formulæ are recommended in some cases for the same insects or diseases. This is to make it easier for those in out of the way places to obtain at least one good insecticide or fungicide.

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